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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Before the Board of Patent Appeals and Interferences

In re Patent Application of

PARKER et al

Serial No. 10/619,556

Filed: July 16, 2003

Title: AN OPTICAL WAVEGUIDE STRUCTURE

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Atty Dkt. 553-74

C# M#

TC/A.U.: 2874

Examiner: S. Pak

Date: July 3, 2006

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

☐ **Correspondence Address Indication Form Attached.**

☐ **NOTICE OF APPEAL**
Applicant hereby **appeals** to the Board of Patent Appeals and Interferences from the last decision of the Examiner twice/finally rejecting applicant's claim(s). $500.00 (1401)/$250.00 (2401) $

☒ An appeal **BRIEF** is attached in the pending appeal of the above-identified application $500.00 (1402)/$250.00 (2402) $ 500.00

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☐ A reply brief is attached. **(no fee)**

☐ Petition is hereby made to extend the current due date so as to cover the filing date of this paper and attachment(s)
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Any future submission requiring an extension of time is hereby stated to include a petition for such time extension. The Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our **Account No. 14-1140.** A duplicate copy of this sheet is attached.

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Signature:

1091098

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of — Confirmation No.: 5931

PARKER et al — Atty. Ref.: 553-74

Serial No. 10/619,556 — Group: 2874

Filed: July 16, 2003 — Examiner: S. Pak

For: AN OPTICAL WAVEGUIDE STRUCTURE

* *

APPEAL BRIEF

On Appeal From Group Art Unit 2167

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APPEAL BRIEF

Sir:

I. REAL PARTY IN INTEREST

The real party in interest in the above-identified appeal is Mesophotonics Ltd. by virtue of an assignment of rights from the inventors to Mesophotonics Ltd. recorded November 20, 2003 at Reel 14724, Frame 51.

II. RELATED APPEALS AND INTERFERENCES

There are believed to be no related appeals, interferences or judicial proceedings with respect to the present application and appeal.

III. STATUS OF CLAIMS

Claims 1-33 stand rejected in the outstanding Final Rejection. The Examiner contends that claims 1, 2, 5, 6, 8-15, 19, 20, 22-24, 26-28 and 30-32 are anticipated by Sigalas (U.S. Patent 6,560,006). The Examiner also contends that claims 16-18 are obvious under 35 USC §103 over Cotteverte (U.S. Patent 6,542,682). There are no rejections of record with respect to claims 3, 4, 7, 21, 25, 29 and 33, yet they appear to be rejected in the Fianl Rejection. The rejections of claims 1-33 are appealed in this appeal.

IV. STATUS OF AMENDMENTS

No response has been submitted with respect to the Final Official Action in this application, except for Appellants' Notice of Appeal and Pre-Appeal Brief Request for Review.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The present invention relates generally to the field of optical waveguide structures and specifically with respect to an improved photonic crystal transmission waveguide.

Photonic crystal waveguide structures are based upon perturbations in the dielectric constant of the core of the planar waveguide structure. Most commonly, such perturbations are created by the etching of air rods or small cylindrical spaces

into the core of the waveguide. As light propagates through the core, it interacts with the dielectric constant modulation and certain portions of the electromagnetic fields are prohibited from propagating within the core. The forbidden electromagnetic fields form a photonic bandgap.

As shown in Figure 1 of Appellants' specification, a prior art photonic crystal including air rods 4 has improved transmission of an optical signal through the waveguide. However, the light propagating through the waveguide is not well confined in the vertical direction, and therefore light from the air rods 4 leaks into the buffer layer 3. This vertical light loss in conventional photonic crystal waveguide structures is very significant and limits the usefulness of such structures in practical devices.

Appellants found that a proper choice of the refractive indices of the core layer, the cladding layer and sub-regions within the core layer, the location of the cladding layer adjacent the core layer, the providing sub-regions within the cladding layer and having the cladding sub-regions contiguous with the core layer sub-regions results in reduced vertical loss in the waveguides and increased efficiency of propagation.

Specifically, Appellants found that it is desirable that the refractive index of the core layer sub-regions, i.e., rods (n_{rods}) minus the refractive index of the core (n_{core}) should be greater than 0.1. Additionally, Appellants found that the refractive index of the core (n_{core}) should be greater than the refractive index of the

cladding ($n_{cladding}$). Appellants also found that the cladding layer should be located adjacent the core layer. Finally, Appellants also found that the cladding layer should also have sub-regions which are contiguous with the core layer sub-regions. The combination of these structures and interrelationship between structures provided low loss transmission of an optical signal.

The substance of Appellants' invention is shown in Figure 2 of Appellants' specification. A core 10 is provided and has a refractive index n_{core}. A plurality of sub-regions - in this instance an array of rods 11 - are located in the core layer 10 and those sub-regions have a refractive index n_{rods}. A cladding layer 13 is provided having a refractive index of $n_{cladding}$, and the cladding layer also has a plurality of sub-regions contiguous with the core layer sub-regions or rods.

In preferred embodiments, there is also a buffer layer 12 which can be mounted on a substrate layer 14. Figure 2 is discussed in the last paragraph on page 7 and all of page 8 and elsewhere in Appellants' specification. The relationship between the refractive indices of the core layer, the plurality of sub-regions or rods and the cladding layer is important and must satisfy the inequalities stated in Appellants' specification on page 8, line 1, i.e., n_{rods} minus n_{core} is greater than 0.1 and n_{core} greater than $n_{cladding}$.

The above interrelationship of core layer, core layer sub-regions, cladding layer and cladding layer sub-regions is set out in Appellants' independent claims 1, 16, 19, 22, 26 and 30. Each of these claims specify either an optical waveguide

structure (claims 1 and 22), a method of manufacturing an optical waveguide structure (claims 16 and 26) and a method of guiding an optical signal (claims 19 and 30). Each of the cited independent claims requires the following structures and structural interrelationships

(a) a plurality of sub-regions within the core layer where the relationship between the core layer sub-region refractive index (n_{rods}) and the core layer refractive index (n_{core}) satisfies the inequality $n_{rods} - n_{core} > 0.1$;

(b) the relationship between the refractive index of the core layer (n_{core}) and the refractive index of the cladding ($n_{cladding}$) satisfies the inequality $n_{core} > n_{cladding}$;

(c) the cladding layer must be located adjacent the core layer;

(d) the cladding layer must also have a plurality of sub-regions; and

(e) the cladding layer sub-regions must be contiguous with the core layer sub-regions.

Appellants' invention is characterized by the five noted structures and structural interrelationships set out in Appellants' six independent claims and therefore is incorporated by reference in all of Appellants' claims.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 2, 5, 6, 8-15, 19, 20, 22-24, 26-28 and 30-32 stand rejected under 35 USC §102(e) as being anticipated by Sigalas (U.S. Patent 6,560,006) (Final Rejection, page 2).

Claims 16-18 stand rejected under 35 USC §103 as being unpatentable over Cotteverte (U.S. Patent 6,542,682) (Final Rejection, page 4).

The Examiner seems to suggest that claims 3, 4, 7, 21, 25, 29 and 33 are somehow rejected (on page 6 of the Final Rejection) but does not specify any basis for rejecting these claims. The Examiner's statement that "the ground of rejection provided for these claims is also proper" does not set forth a ground of rejection under the Patent Statutes and therefore there is no specified ground of rejection specified for claims 3, 4, 7, 21, 25, 29 and 33.

VII. ARGUMENT

Appellants' arguments include the fact that the burden is on the Examiner to first and foremost properly construe the language of the claims to determine what structure and/or method steps are covered by that claim. After proper construction of the claim language, the burden is also on the Examiner to demonstrate where a single reference (in the case of anticipation) or a plurality of references (in the case of an obviousness rejection) teaches each of the structures and/or method steps recited in independent claims 1, 16, 19, 22, 26 and 30.

The Court of Appeals for the Federal Circuit has noted in the case of *Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick*, 221 USPQ 481, 485 (Fed. Cir. 1984) that "[a]nticipation requires the presence in a single prior art

reference disclosure of each and every element of the claimed invention, arranged as in the claim."

Furthermore, the Court of Appeals for the Federal Circuit has stated in the case of *In re Rouffet*, 47 USPQ2d 1453, 1458 (Fed. Cir. 1998)

> to prevent the use of hindsight based on the invention to defeat patentability of the invention, this court **requires** the examiner to show a **motivation** to combine the references that create the case of obviousness. In other words, the Examiner **must show reasons** that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed. (emphasis added).

A. No basis for rejection of claims 1, 2, 5, 6, 8-15, 19, 20, 22-24, 26-28 and 30-32 under 35 USC §102 as anticipated by Sigalas

The Examiner rejects claims 1, 2, 5, 6, 8-15, 19, 20, 22-24, 26-28 and 30-32 under 35 USC §102 as anticipated by Sigalas (USP 6,560,006). As noted above in the *Lindemann* case, the burden is on the Examiner to establish that each and every element and claimed interrelationship between elements is shown in the single Sigalas reference. Appellants have identified five structures or structural interrelationships set out in each of Appellants independent claims, and all of which combinations are not believed to be shown in any single reference of record, including Sigalas.

In conjunction with the Examiner's §102 rejection of Appellants independent claims, Figure 1 of Sigalas is illustrated on page 2 of the Official

Action and is described as being a "first embodiment of the invention." (Sigalas, Column 4, lines 12-14). However, also in conjunction with the alleged support for the §102 rejection, the Examiner also discusses the Sigalas waveguide structure of Figure 10 (page 3 of the Final Rejection). Sigalas indicates that Figure8 is a "process for fabricating a Si-based two-dimensional photonic crystal slab according to one embodiment of the present invention" (column 6, lines 12-14) and that an "alternative processing route" for this "one embodiment" is disclosed in Figures 10a-10g.

Thus, in order to properly analyze the Sigalas reference, one must look at the "first embodiment" shown in Figure 1 and then to the different embodiment created by the method shown in Figures 10a-10g. Of course, it would be improper to pick and choose portions of two different embodiments and then combine them in the manner suggested by Appellants' independent claims.

1. Sigalas Figure 1 - the "first embodiment"

Firstly, looking at the Sigalas reference in Figure 1, the Examiner admits that it is comprised of "air slab body and rods" (Final Rejection, page 2) and as stated in Sigalas,

> in the illustrated embodiment, the periodic lattice is composed of a two-dimensional array of posts 22 that comprise rods of a material having a high dielectric constant, for example, Si or GaAs, and the slab body, designated by reference number 24, comprises air.

(Column 4, lines 17-22).

If for the purposes of discussion, we construe the core material to be air slab 24 and the sub-regions to be the silicon rods 22, then, as noted by the Examiner, the refractive index of the air slab body is 1 and therefore n_{core} equals 1. The refractive index of the rods, if silicon, is admitted by the Examiner to be between 3 and 4 (the Examiner cites Sigalas at column 6, line 3 for this proposition). Thus, the Examiner's analysis would appear to suggest that Sigalas does meet the claim requirement "(a)", i.e., n_{rods} greater than n_{core}.

However, it is noted that Applicants claims recite a core and then a plurality of core subregions. Thus, the subregions would appear to be smaller in size than the core itself. This is why Appellant construes the single recited core to be air and the sub-regions, i.e., the rods, to be Si as noted above. However it appears that in some embodiments the Examiner is construing the rods or subregions to comprise the core and the cladding - this will be noted later in the brief.

Turning back to Figure 1, Sigalas at column 5, line 65 through column 6, line 3, teaches that the "refractive index of the cladding layer should range from 1-2.0, and the refractive index of the dielectric rods 22 (the core) should be between 3 and 4." Thus, if Sigalas is actually referring to the "core" as defined in the appealed claims, then it would meet the claim requirement of "(b)", i.e., $n_{core} > n_{cladding}$. However, since Sigalas in Figure 1 teaches the core to be air slab 24 and the only existent "sub-regions" of the core are the rods 22, then Sigalas in teaching

n_{core} to be 1, and $n_{cladding}$ to be 3-4, actually teaches away from the claimed inequality and, instead, suggests that in his device $n_{cladding} > n_{core}$. Thus, if Sigalas is construed consistently, either claim interrelationship “(a)” or “(b)” is not met.

The Examiner cannot have it both ways – either the air slab body in Sigalas' Figure 1 is the "core" and has a refractive index of 1 (in which case claim requirement “(b)”[$n_{core} > n_{cladding}$] is not met because the cladding refractive index is 3-4) or the “core” is the dielectric rods 22 themselves (identified as "the core" at column 6, line 2) which have a refractive index of 3-4 (in which case, claim requirement “(a)” [$n_{rods} - n_{core} > 0.1$] is not met).

Indeed, in Sigalas the only plurality of items making up the core are the sub-regions 22 identified as rods, whereas the remainder of the core is a single "slab" or air. Thus, even though Sigalas identifies the core at column 6, line 2 as being rods 22, those rods are the only structure in Sigalas' Figure 1 which meet the claim requirement of a “plurality” of “sub-regions” in the core and therefore items 22 must be the rods.

As a result of the above, assuming that the air slab is the core and rods 22 are the required plurality of sub-regions, then the Sigalas teaching that the refractive index of the cladding layer index of refraction should range from 1 to 2 does not satisfy the claimed requirement that the n_{core} be greater than $n_{cladding}$ (because the core air slab has a refractive index of 1 and, as stated in column 6, line 1, the Sigalas cladding has a refractive index of from 1 to 2). At best, Sigalas

teaches that the air slab and the cladding should have the same refractive index and where the cladding is anything other than 1, Sigalas teaches the direct opposite of Appellants' claimed relationship. Sigalas, at best teaches equality and not the claimed inequality.

With respect to interrelationship “(c)” set out in Appellants' independent claims, Sigalas does appear to have the cladding 34 and cladding 36 "adjacent said core layer." However, the Examiner does not point to any location in the Sigalas Figure 1 which shows the claimed "plurality of sub-regions within the cladding layer" i.e., structure “(d)” in Appellants' independent claims, or that the "cladding layer sub-regions [be] contiguous with said core layer sub-regions" i.e., interrelationship “(e)”.

Thus, if properly considered, the Sigalas reference in Figure 1, at best, teaches claimed structures and interrelationships (a) and (c), but does not teach, and indeed teaches away from, structures and interrelationships (b), (d) and (e). As a result, Sigalas at Figure 1 does not anticipate nor does it render obvious the subject matter of Appellants' independent claims 1, 16, 19, 22, 26 and 30 and any further rejection thereunder is respectfully traversed.

2. Sigalas Figures 8 and 10 - another "embodiment"

Turning to the embodiment disclosed in Figure 10 of Sigalas, Figure 10a designates element 106 as the core layer and elements 102 and 104 as the cladding layer (column 7, lines 43-49). However, Sigalas then discloses his etching and wet oxidation process which removes all of the cladding and core layers around a series of rods. This is described in somewhat greater detail with reference to Figure 8. Thus, like Figure 1, the core comprises an air slab with a plurality of sub-regions, i.e., rods made up of cladding/core/cladding layers.

The description of Figure 8 teaches that a planarizing medium 72 fills in the area "around the dielectric rods 68." (Column 6, lines 39-41). Thus, what the Examiner considers the "core layer 106" is in fact a plurality of sub-regions formed by dielectric rods which are surrounded by air in Figure 10b and then filled with the claimed "planarizing" material which is identical to the planarizing step disclosed with reference to Figure 8 (see column 7, lines 54-56).

The planarizing material used in Figure 10 is disclosed as being the same as that used in Figure 8 ("as described above for the Si process" Col. 7, line55) which is identified as comprising "polyimide, spin-on glass or PECVD grown SiO_2." (Column 6, lines 39-43). Thus, the structure shown in Figures 10c-10g comprise a plurality of varying dielectric rods immersed within a single layer of planarizing material, i.e., in the example, SiO_2. The organization of dielectric rods 68 is

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disclosed in conjunction with the Figure 8 process of fabricating "one embodiment of the present invention" and is discussed at column 6, lines 27-34.

If the planarizing medium in Figure 10b is considered to be the core and the sub-regions are the rods formed of core layer 106 and cladding layers 104 and 102, then we have the situation in which the core (planarizing layer) which is disclosed as being SiO_2 having a refractive index of 3-4 and the plurality of sub-regions, i.e., the varying refractive index rods, with portions of which have a refractive index equal to 3-4 and other portions having a refractive index less than 3-4. This construction fails to meet the requirement "(a)", i.e., of $n_{rods} - n_{core} > 0.1$.

Thus, while it is difficult to follow the Examiner's analysis, it is believed that whichever way the Examiner construes the Figure 10 embodiments, the core layer and the plurality of sub-regions within the core layer (whichever is the sub-regions and whichever is the core layer itself), it will be clear that Sigalas is essentially the pbverse of Appellants' claimed invention. Appellants' claimed invention is a core layer which has a single general refractive index n_{core}. Within the core layer there are a plurality of sub-regions which tells those having ordinary skill in the art that such sub-regions are lesser in size than the core layer itself (since they are located within the core layer). Appellants' specification defines these sub-regions as "rods," although the physical configuration is not limited to a particular cylindrical shape.

It is believed that the Sigalas reference etches away the material of the cladding/core/cladding combination so as to leave only a plurality of rods having this varying dielectric and then adds the "planarizing" layer which forms a greater portion of the core layer than the otherwise remaining rod-shaped portions made of the cladding/core/cladding material.

As a result, Sigalas would clearly lead one of ordinary skill in the art away from Appellants' combination of elements, i.e., a core layer with one refractive index and a plurality of sub-regions within the core layer, each rod having a varying refractive index, where the relationship between the two refractive indices is n_{rods} greater than n_{core}. Sigalas does not teach any embodiment which meets the n_{rods} greater than n_{core} interrelationship while at the same time meeting the n_{core} greater than $n_{cladding}$ interrelationship.

While there are numerous embodiments, the Examiner may not pick and choose refractive indices from different portions of different embodiments as examples of Sigalas teaching Appellants' independent claims. In the Examiner's Answer to this Brief, he is respectfully requested to identify specific embodiments in Sigalas that contain all of the interrelationships set out in Appellants' independent method claims 1, 16, 19, 22, 26 and 30. Absent such identification, the rejection of claims 1, 2, 5, 6, 8-15, 19, 20, 22-24, 26-28 and 30-32 fails because the Examiner has failed to identify where a single prior art reference

contains a "disclosure of each and every element of the claimed invention, arranged as in the claim." *Lindemann*, at 485.

B. The Examiner does not establish how or where Cotteverte renders obvious the subject matter of claims 16-18

Claims 16-18 stand rejected under 35 USC §103 as obvious in view of Cotteverte. Appellants' independent claim 16 specifies a method of manufacturing an optical waveguide comprising a plurality of steps. The steps comprise providing a core layer having a first refractive index n_{core}, forming a plurality of holes in the core layer and filling those holes with a material having a second refractive index, i.e., n_{rods}. The claim requires that (a) the inequality n_{rods} minus n_{core} greater than 0.1 be met. The claim goes on to specify (c) the provision of a cladding area which is adjacent the core layer and (b) which satisfies the requirement of n_{core} greater than $n_{cladding}$. Finally, the claim requires the step of providing (d) a plurality of holes within the cladding layer and (e) where the cladding layer holes are contiguous with the core layer holes.

Firstly, the Examiner misapprehends the Cotteverte reference wherein he states that Cotteverte contains "providing a buffer layer ('104' Fig. 14)." It is noted that the discussion of Figure 14 specifies the components as being "core layer 102, an overclad layer 104, and an underclad layer 106." (Column 8, lines 2-4).

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Cotteverte specifies that "the overclad layer 104 and the underclad layer 106 have refractive indices lower than that of the core layer 102." (Column 8, lines 4-6). This interrelationship would seem to meet the claim 16 requirement "(b)" of providing a cladding layer where $n_{core} > n_{cladding}$.

However, the Examiner admits that Cotteverte "does not explicitly teach the refractive index of the filling material being greater than that of the core layer." Thus, the Examiner is admitting that Cotteverte contains no teaching of interrelationship "(a)", i.e., $n_{rods}-n_{core}>0.1$.

Moreover, the Examiner ignores the Cotteverte teaching at column 8, line 41 that "columns 108 may be filled with air" or some other unidentified material. If filled with air, the columns will have a refractive index equal to 1, as noted by the Examiner in conjunction with the Sigalas reference. If the rods have a refractive index of 1, Cotteverte clearly cannot meet the Appellants' claim requirement "(a)" that $n_{rods} - n_{core} > 0.1$, as there are no materials having a refractive index less than 1 identified in the Cotteverte reference.

While the Examiner correctly notes that Cotteverte at column 8, lines 41-44 does teach that the holes may be filled with either air or "another material" and that it is preferable that "the material of the columns has a refractive index that is substantially <u>different</u> than the bulk photonic crystal material," (emphasis added) such refractive index could be substantially <u>greater than</u> or substantially <u>less than</u> the bulk photonic crystal material refractive index. The Examiner clearly admits

that Cotteverte does not specify any particular refractive index. Thus, in view of the Examiner's admission, Cotteverte does not contain any teaching of Appellants' claimed interrelationship $n_{rods}-n_{core}>0.1$. Absent such teaching in the only cited reference, Cotteverte, there is no support for any rejection of claims 16-18 as obvious under 35 USC §103.

The Examiner attempts to "gloss over" his admission by stating that "providing filling material in the photonic crystal holes with material having refractive index higher than the core layer is well known in the art." The Examiner has not previously made this argument, so Appellants have not had an opportunity to respond. However, Appellants would note the requirement of MPEP Section 2144.03 and point out that it specifically traverses the Examiner's assertion.

If the Examiner attempts to cite a reference in support of his position, it will be noted that the entire teaching of that reference must be taken into consideration, not merely one specific interrelationship. It is noted that Appellants' claim 16 requires a series of method steps, a number of which require specific interrelationships between materials used in the method steps, i.e., $n_{rods}-n_{core}>0.1$ and $n_{core}>n_{cladding}$, as well as the cladding layer holes being contiguous with the core layer holes and the cladding located adjacent the core layer.

The Examiner has simply attempted to avoid the consequence of his failure to cite a prior art reference by suggesting that the claimed interrelationship is "well

known in the art." The Examiner is respectfully requested to cite a prior art reference containing such a disclosure or otherwise abandon the rejection of claims 16-18. It is noted that claims 17 and 18 provide at least the interrelationship of n_{rods} greater than n_{core} greater than $n_{cladding}$, and the Examiner is respectfully requested to point out where or how he believes Cotteverte or any other reference teaches this interrelationship between claimed elements.

Additionally, should the Examiner in the Examiner's Answer cite an additional reference allegedly showing filling the holes with a material having a refractive index higher than the refractive index of the core layer, the Examiner is also requested to meet the requirements of *In re Rouffet* noted above, i.e., he is requested to show, as required by the Court, "a motivation to combine the references that create the case of obviousness." The Federal Circuit has stated that the Examiner

> must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed.

If the Examiner cannot make a reasonable showing of the required "reasons" or "motivation" to combine Cotteverte and the as yet unidentified reference, then even if bits and pieces of the claimed invention are shown in the two references, the Examiner has not met the Court-imposed burden of preventing the use of hindsight based on Appellants' claimed invention. Accordingly, any

further rejection of Appellants' independent claims 1, 16, 19, 22, 26 and 30 is respectfully traversed over Cotteverte by itself or in combination with any as yet identified reference.

VIII. CONCLUSION

As noted above in the beginning of Appellants' argument portion, the burden is on the Examiner in the case of an "anticipation" rejection to establish how or where a single prior art reference discloses each and every claimed element of the claimed invention arranged as in the claim. The Examiner ignores claimed limitations, i.e., the Sigalas Figure 1 does not meet the requirements $n_{core}>n_{cladding}$ nor does it meet the requirement of a plurality of sub-regions in the cladding layer, nor does it meet the requirement of cladding sub-regions being contiguous with core sub-regions. The Sigalas Figure 10 does not meet the requirements of Appellants' claims because in the best embodiment, the $n_{rods}>n_{core}$ limitation is not met, since the planarizing medium can be considered to be the rods having an index of 1-2 and the core has an index of 3-4. This is the closest construction to Appellants' claimed invention. If the rods and core layer are reversed, then it would not meet the relationship $n_{core}>n_{cladding}$ and several other claimed limitations.

In an obviousness rejection, the Examiner also has the burden of showing where the claimed structure exists in one or more references and in the case of a

plurality of references, where there is some suggestion or reason for combining the references. While the Examiner admits that Cotteverte fails to teach a claimed interrelationship, his suggestion that it is somehow well known in the art does not meet his burden under *In re Rouffet.*

The Examiner fails to provide any basis upon which claims 3, 4,7, 21, 25, 29 and 33 are rejected, and therefore these unrejected claims are believed in condition for allowance.

Thus, in view of the above, the rejections of claims 1, 2, 5, 6, 8-20, 22-24, 26-28 and 30-32 under 35 USC §102 and §103 are clearly in error and reversal thereof by this Honorable Board is respectfully requested. The failure to reject claims 3, 4, 7, 21, 25, 29 and 33 is taken as an indication that these claims contain allowable subject matter and confirmation thereof by the Board is respectfully requested.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: ____________________

Stanley C. Spooner
Reg. No. 27,393

SCS:kmm
Enclosure

IX. CLAIMS APPENDIX

1. An optical waveguide structure comprising:

a core layer having a first refractive index n_{core},

a plurality of sub-regions within the core layer, said core layer sub-regions having a second refractive index n_{rods}, wherein $n_{rods}-n_{core} > 0.1$, said core layer sub-regions arranged in at least one array, the array of core layer sub-regions extending longitudinally along the waveguide and comprise a photonic band structure within the core layer for propagating an optical mode traveling through said waveguide structure,

a cladding layer, said cladding layer located adjacent said core layer, said cladding layer having a thrd refractive index, $n_{cladding}$, where $n_{core}>n_{cladding}$, and

a plurality of sub-regions within the cladding layer, said cladding layer sub-regions contiguous with said core layer sub-regions.

2. An optical waveguide structure according to claim 1, wherein the waveguide structure is a planar waveguide structure, the core layer being formed between said cladding layer and a buffer layer, and the buffer layer having a fourth refractive index, n_{buffer}, where

$n_{core} > n_{buffer}$.

3. An optical waveguide structure according to claim 1, wherein the waveguide structure is an optical fibre, said cladding layer comprising an annular layer surrounding the core layer.

4. An optical fibre according to claim 3, wherein the cladding layer is planarised in the vicinity of the plurality of cladding layer and core layer sub-regions.

5. An optical waveguide structure according to claim 1, wherein the core layer and cladding layer of sub-regions provides a photonic bandgap.

6. An optical waveguide structure according to claim 1, wherein the core layer sub-regions are formed from silicon.

7. An optical waveguide structure according to claim 1, wherein the core layer is formed from silicon nitride, silicon oxynitride, doped silica, tantalum pentoxide or doped tantalum pentoxide.

8. An optical waveguide structure according to claim 2, wherein the cladding layer is formed from silicon dioxide.

9. A planar optical waveguide structure according to claim 2, wherein the cladding layer sub-regions comprise the same material as the core layer sub-regions.

10. A planar optical waveguide structure according to claim 2, further comprising a plurality of sub-regions in said buffer layer, the buffer layer sub-regions are continuous with said core layer sub-regions.

11. An optical waveguide structure according to claim 1, wherein the cladding layer sub-regions have a refractive index which is greater than or equal to the refractive index of the cladding layer but which is less than or equal to the refractive index of the core layer.

12. An optical waveguide structure according to claim 1, wherein the core layer sub-regions are arranged in a square lattice.

13. An optical waveguide structure according to claim 1, wherein the core layer includes a waveguiding region having no sub-regions.

14. An optical waveguide structure according to claim 13, wherein the waveguiding region includes a bend.

15. An optical device incorporating an optical waveguide structure according to claim 1.

16. A method of manufacturing an optical waveguide structure comprising the steps of:

providing a core layer having a first refractive index n_{core};

forming a plurality of holes in the core layer extending longitudinally along the waveguide; and

filling the holes with a material having a second refractive index n_{rods}, wherein:

$n_{rods}-n_{core} > 0.1$

providing a cladding layer, said cladding layer located adjacent said core layer, said cladding layer having a thrd refractive index, $n_{cladding}$, where $n_{core}>n_{cladding}$, and

providing a plurality of holes within the cladding layer, said cladding layer holes contiguous with said core layer holes.

17. A method according to claim 16, wherein the optical waveguide is a planar waveguide and said core layer has at least two sides, the method further including the steps of:

providing a buffer layer having a refractive index n_{buffer} on one side of the core layer; and

the step of providing said cladding layer , provides said cladding layer on the other side of the core layer, wherein:

$n_{rods} > n_{core} > n_{cladding}$ and n_{buffer}.

18. A method according to claim 16, wherein the optical waveguide is an optical fibre, the method further including the steps of:

providing said cladding layer surrounding the core layer, wherein:

$n_{rods} > n_{core} > n_{cladding}$.

19. A method of guiding an optical signal comprising the step of passing an optical signal through a waveguiding region of an optical waveguide structure comprising:

a core layer having a first refractive index n_{core},

an array of sub-regions within the core layer extending longitudinally along the waveguide having a second refractive index, n_{rods}, the array of sub-regions comprising a photonic band structure within the core layer, wherein:

$n_{rods}-n_{core} > 0.1$

a cladding layer, said cladding layer located adjacent said core layer, said cladding layer having a thrd refractive index, $n_{cladding}$, where $n_{core}>n_{cladding}$, and

a plurality of sub-regions within the cladding layer, said cladding layer sub-regions contiguous with said core layer sub-regions.

20. A method according to claim 19, wherein the waveguide is a planar waveguide, wherein the core layer is formed between a cladding layer and a buffer layer, and the buffer layer having a fourth refractive index, n_{buffer}, and where:

$n_{core} > n_{buffer}$.

21. A method according to claim 19, wherein the optical waveguide is an optical fibre, wherein said cladding layer surrounds the core layer, and wherein:

$n_{rods} > n_{core} > n_{cladding}$.

22. An optical waveguide structure comprising

a core layer, said core layer having a first refractive index n_{core},

a 2-dimensional array of sub-regions within the core layer, said core layer sub-regions having a second refractive index n_{rods}, the array of core layer sub-regions extending longitudinally along the waveguide and comprising a photonic band structure within the core layer, wherein:$n_{rods} > n_{core}$

a cladding layer, said cladding layer located adjacent said core layer, said cladding layer having a thrd refractive index, $n_{cladding}$, where $n_{core}>n_{cladding}$, and

a plurality of sub-regions within the cladding layer, said cladding layer sub-regions contiguous with said core layer sub-regions.

23. An optical waveguide structure according to claim 22, wherein $n_{rods} - n_{core} > 0.1$.

24. An optical waveguide structure according to claim 22, wherein the waveguide structure is a planar waveguide structure, the core layer being formed between said cladding layer and a buffer layer, and the buffer layer having a fourth refractive index n_{buffer}, wherein:

$n_{core} > n_{buffer}$.

25. An optical waveguide structure according to claim 22, wherein the waveguide structure is an optical fibre, said cladding layer surrounding the core layer.

26. A method of manufacturing a optical waveguide structure comprising the steps of:

providing a core layer having a first refractive index n_{core};

forming a 2-dimensional array of holes in the core layer extending longitudinally along the waveguide structure;

filling the holes with a material having a second refractive index n_{rods}, wherein:

$n_{rods} > n_{core}$

providing a cladding layer, said cladding layer located adjacent said core layer, said cladding layer having a thrd refractive index, $n_{cladding}$, where $n_{core}>n_{cladding}$, and

providing a plurality of holes within the cladding layer, said cladding layer holes contiguous with said core layer holes.

27. A method according to claim 26, wherein $n_{rods}-n_{core} > 0.1$.

28. A method according to claim 26, wherein the optical waveguide is a planar waveguide and said core layer has at least two sides, the method further including the steps of:

providing a buffer layer having a refractive index n_{buffer} on one side of the core layer; and

the step of providing said cladding layer on the other side of the core layer, wherein:

$n_{rods} > n_{core} > n_{cladding}$ and n_{buffer}.

29. A method according to claim 26, wherein the optical waveguide is an optical fibre, the method further including the steps of:

providing said cladding layer surrounding the core layer, wherein:

$n_{rods} > n_{core} > n_{cladding}$.

30. A method of guiding an optical signal comprising the step of passing an optical signal through a waveguiding region of an optical waveguide structure comprising:

a core layer, said core layer having a first refractive index n_{core},

a 2-dimensional array of sub-regions within the core layer extending longitudinally along the waveguide having a second refractive index n_{rods}, the array of sub-regions comprising a photonic band structure within the core layer, wherein:

$n_{rods} > n_{core}$

a cladding layer, said cladding layer located adjacent said core layer, said cladding layer having a thrd refractive index, $n_{cladding}$, where $n_{core}>n_{cladding}$, and

a plurality of sub-regions within the cladding layer, said cladding layer sub-regions contiguous with said core layer sub-regions.

31. A method according to claim 30, wherein $n_{rods}-n_{core} > 0.1$.

32. A method according to claim 30, wherein the waveguide is a planar waveguide, wherein the core layer is formed between said cladding layer and a buffer layer, and the buffer layer having a fourth refractive index n_{buffer}, and wherein:

$n_{core} > n_{buffer}$.

33. A method according to claim 30, wherein the optical waveguide is an optical fibre, wherein said cladding layer surrounds the core layer, and wherein:

$n_{rods} > n_{core} > n_{cladding}$.

X. EVIDENCE APPENDIX

None.

XI. RELATED PROCEEDINGS APPENDIX

None.